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# THE MEANS OF VICTORY

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## A SPEECH

delivered by

**The Rt. Hon. Edwin Montagu, M.P.,**

**MINISTER OF MUNITIONS,**

on the

15th AUGUST, 1916.

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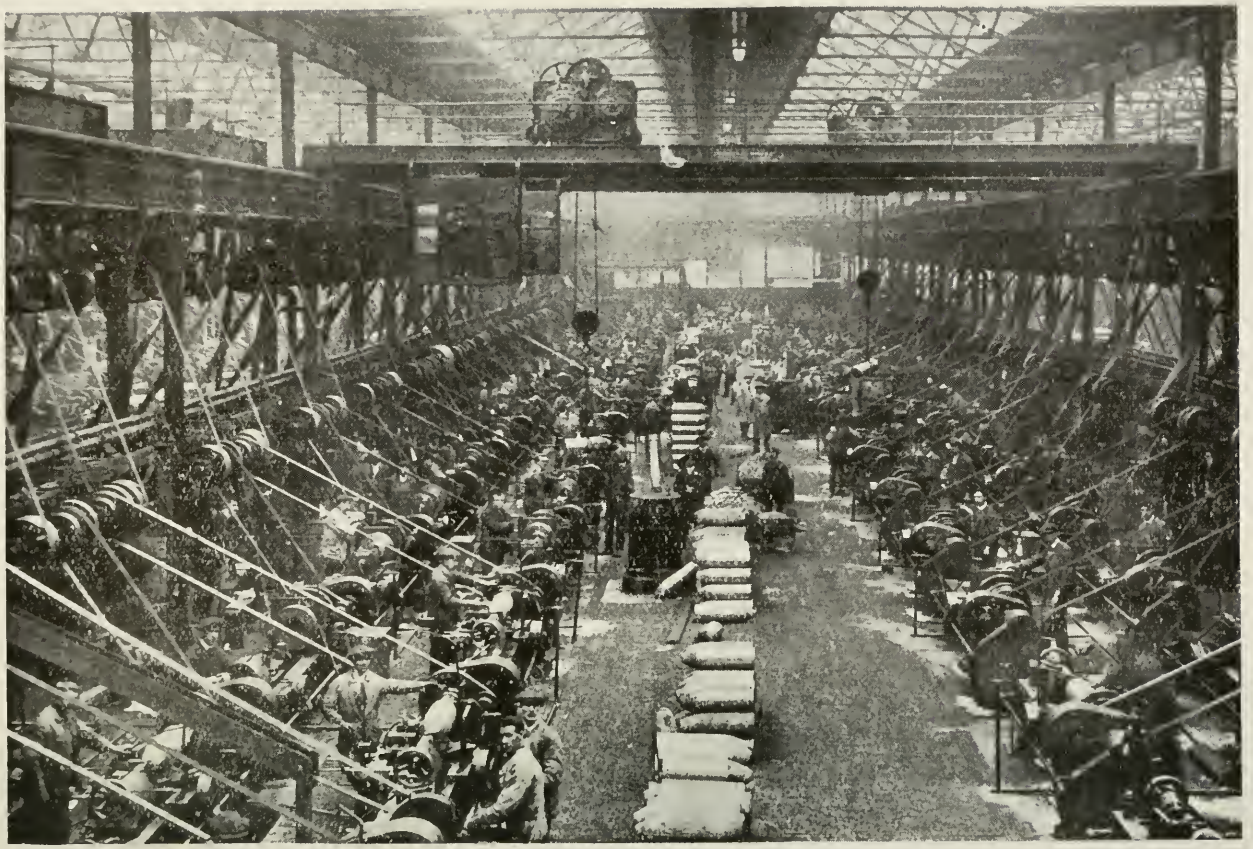


SECTION OF A TURNING SHOP.

(*To face p.* 3.)

# THE MEANS OF VICTORY.

A Speech delivered by

## THE RT. HON. EDWIN MONTAGU, M.P.,

MINISTER OF MUNITIONS.

I HAVE a very long, and if I could only express it adequately, a very interesting story to tell the House. I think there has been no Debate on the Ministry of Munitions since December last, when my right hon. Friend, who is now Secretary of State for War, gave the House an account of the marvellous work which has been accomplished and outlined the work that still remained to be done, and warned us that if the nation did not throw itself heart and soul into the struggle they might find themselves too late. I should like to take the story up where he left it, and I feel sure that I shall have the sympathy of the House when I remind them that I have only been in the office for a month, and that I cannot pretend to know very much about it myself. Even if I knew everything that was to be known it would be impossible to describe the whole Ministry and all its activities in one



(6536.)

speech, however long, and therefore I propose to take one or two features of our work and try and describe them.

## THE OUTPUT OF AMMUNITION.

I will take, first, the question of output, for it is by this first and foremost that the House and the nation will ultimately judge the Ministry of Munitions. I will begin with shells. Figures have been given for some other countries showing the increase in the output of empty shell as a percentage of the output at the beginning of the War. But our output, which was only expected to supply an Army of 200,000 men, was so negligible that percentages on such a basis give quite fantastic results. For example, the empty shell output from home sources has increased since September, 1914, 170 times in the case of 18-pounder shells, and 2,650 times in heavy natures.

I prefer to take as my basis of comparison the average weekly production of complete rounds up to the end of June, 1915, a year before the Ministry of Munitions came into existence. Compared with that, the rate of production of 18-pounder ammunition during the year 1915-16 was six and a half times that during the preceding year, and for the week ended 1st July,

1916, it was seventeen and a half times as great as the average rate in 1914-15. The weekly average production of ammunition for field howitzers in 1915-16 was eight times that for 1914-15 and is now twenty-seven times as great. The production of ammunition for medium artillery increased seven and a half times in 1915-16, and is now more than thirty-four times as great as the average weekly production up to the end of June, 1915. The greatest increase of all has been in the class of ammunition where increase was most difficult. The average weekly production of heavy shell was in 1915-16 twenty-two times as great and is now ninety-four times as great as it was in 1914-15. These figures can be put in another way, and even, I think, more graphically. The output which, in 1914-15, it took twelve whole months to produce can now be attained from home sources in the following periods:

For 18-pounder ammunition in three weeks;
For field howitzer ammunition in two weeks;
For medium-sized shell in eleven days; and
For heavy shell in four days.

That is to say, we are now producing every four days as much heavy howitzer ammunition as it took us a whole year to produce at the rate of

output of 1914-15. If we lump all natures of gun and howitzer ammunition together, we are now manufacturing and issuing to France every week about as much as the whole pre-war stock of land service ammunition in the country.

### OUR BIG GUNS.

I come next to artillery, which is one of the greatest features of development. Fifteen months ago the Navy absorbed by far the greater part of the factories suitable for manufacturing big guns. The armament firms of the country had very little machinery or plant capable of undertaking more than a mere fraction of the Army gun programme, and it was necessary to provide very large extensions of buildings and to equip them with new machinery. I am told that the area occupied by the new buildings amounts to 1,000,000 square feet, and it has been necessary to provide new machine tools to the number of over 2,500 to cope with the work. In addition to the armament firms, hundreds of other engineering concerns all over the country have been engaged in carrying out the work of the programme, building gun carriages, ammunition wagons, and all the various accessories and spare parts required for artillery. The result of these efforts is very

marked. We are now turning out in a month nearly twice as many big guns as were in existence for land service when the Ministry of Munitions started. The monthly output of heavy guns increased more than sixfold between June, 1915, and June, 1916, and the present rate of output will eventually be nearly doubled. By June, 1916, the monthly output of the 4.5-in. howitzers had become three times as great as in June, 1915. For every 100 18-pounders turned out between the outbreak of War and the 31st of May, 1915, about 500 were turned out in the following year. As the equipment of 18-pounders is now practically complete, manufacturing capacity, except such as is required for repairs and renewals, has been transferred to other uses. I would remind the House that all this has been done when, I think, something like half the engineering capacity of this country is still hypothecated to the Navy.

### MACHINE GUNS AND RIFLES.

I turn to machine guns. The number of machine guns accepted from the outbreak of War to the end of May, 1915, was only one-eighteenth of the number accepted in the next twelve months, the weekly output having increased, since the Ministry of Munitions was

founded, fourteenfold, and it is still increasing. The total stock existing when the Ministry was formed could be replaced in from three to four weeks at the present rate of output. The wastage of machine guns during periods of active operation is very heavy, and the demands of the War Office are continually increasing both for ground and aircraft work. But, notwithstanding great increases, we shall very shortly have satisfied all the requirements of the British Army. [An Hon. Member asked a question which was inaudible.] I said, although the requirements are continually increasing, even the latest increases we shall have satisfied in a very short time, and I hope we will be able to turn our manufactures to the benefit of our Allies. Rifles are more difficult to increase than any other munition of war. Nearly three times as many new rifles of home manufacture were accepted after inspection in the first year of the Ministry's activities as were accepted from the outbreak of War to the constitution of the Ministry. In addition, many hundreds of thousands of rifles have been repaired and resighted. I understand rifles have always been the chief factor limiting the number of men who can be put in the field, and the best evidence therefore of the progress of rifle output is the

size of the Army that we are now able to arm and maintain overseas. It is a matter for congratulation that the equipment of our whole Army, both in machine guns and rifles, has been accomplished from home sources alone. [An Hon. Member: "America!"] What I said is true. The arming of our Army now overseas, as regards machine guns and rifles, has been wholly done from home sources.

In obtaining these results the chief credit should be given to the Royal Small Arms Factory at Enfield, which has done very good work and turned out more rifles than was thought possible, and has assisted and co-ordinated the other factories. Without its help I do not think the increase in British output would have been anything like what it has been. The home production of small-arms ammunition is now three times as much per week as a year ago. The output of small-arms ammunition has necessitated the co-ordination of the brass and cupro-nickel strip manufacture, and the results have been so satisfactory that there has been no shortage in supply. We have been able to meet all demands for ammunition made by the War Office and yet at the same time build up a stock which should remove any anxiety for the future. Additional supplies have been arranged

in order further to assist our Allies, and this contribution will reach very important proportions in the near future.

### THE OUTPUT OF EXPLOSIVES.

As to explosives, the production of high explosives is sixty-six times as large as it was at the beginning of 1915, by far the most of it being produced in Government factories. The House may guess what work has been needed to reach the present production of high explosives when I say that the weekly consumption of high explosives in ammunition of all kinds is now between 11,000 and 12,000 times the amount required for the land-service ammunition manufactured in September, 1914. In regard to trench warfare, in addition to the great increase in the supply of guns and gun ammunition, special attention has been directed to mortars and ammunition for trench warfare. Heavy and light mortars are now coming forward in large quantities with corresponding supplies of ammunition. The output of bombs increased thirty-three-fold between May, 1915, and May, 1916. If we compare the weight of contained explosive, we find that 150 times the amount of explosive was required to fill the bombs at the later than at the earlier date. Before I leave the

subject of output, these figures, striking as they are, do not by any means represent the whole of our material contribution to the common needs of the Allied cause. I say nothing of the assistance we are giving in supplies of food and other materials not intended for the destruction of human life, or the incalculable services of the Navy and the merchant service. I am dealing only with the services rendered by the Ministry of Munitions.

### HELPING OUR ALLIES.

A substantial quantity of finished munitions is being manufactured for the Allies in our national factories and by private firms. They include shells, field howitzers, heavy guns, grenades, machine guns, and small-arms ammunition. We are sending to France one-third of the whole British production of shell steel. This is one of our most important contributions to the Allied cause. Steel is the basis of modern war, and the loss of the Northern provinces of France has robbed our Ally of nearly three-quarters of her steel-producing capacity. There are numerous other metals which, through a system of common purchase which was established some time ago and is now being developed, this country is supplying to our various Allies. These are metals either made in this country or

purchased in the Empire or in neutral countries. They include copper, antimony, lead, tin, spelter, tungsten, mercury, high-speed steel and other less important substances. I can give the House the best idea of the magnitude of these metal transactions when I say that the monthly value of those supplied to the Allies is £6,000,000 sterling, while the method of purchase adopted has already, under that limitation of prices, secured a saving of over £41,000,000, a benefit which is shared with the Allies. [An Hon. Member: "Per annum?"] That is what has already been saved. We are also sending the Allies the constituents of explosives in very large quantities, manufactured at our national factories mainly, or with the new plant which the enterprise and initiative of Lord Moulton's Department has established in many gasworks throughout the country. We are supplying them with millions of tons of coal and coke per month, and with large quantities of machinery. Machine tools, as my right hon. Friend explained to the House last December, are one of the most essential factors in the manufacture of munitions, and 20 per cent. of the present machine-tool production of this country is destined for the Allies. After that, I think the munition workers of this country

may flatter themselves that they have borne some part in the glorious victories of Russia, Italy and France. That is all I have to say of quantities. I pass now to quality.

### IMPROVEMENT IN QUALITY.

The principle we go upon is that of endeavouring to supply both our Allies and ourselves, distributing to the best advantage the goods that we obtain either from this country or from abroad. I think it will be satisfactory to the House to learn that, so far as one can judge, concurrently with, I might almost say in spite of, this remarkable increase in quantity, there has been a substantial and satisfactory improvement in the quality of the material which we are supplying.

### THE WORK OF THE DESIGNERS.

I do not envy the responsibility of those whose business it is to provide the design of weapons and of ammunition. Eight months ago the responsibility for design was transferred from the War Office to the Ministry of Munitions, because in the belief of those who were responsible for the Ministry at the time you cannot divorce the responsibility for design from the responsibility for supply.

This transfer has greatly contributed to

efficient and smooth working collaboration between officers responsible for the design and quality of munitions, and those responsible for supply. The former have worked untiringly at their special task, and are to be congratulated on the results of their labour. The problems they have to deal with can only be referred to in very general terms, but as regards the artillery itself no secret is divulged in saying that our new artillery material has acquitted itself during the recent fighting to the entire satisfaction of the British Army. I received yesterday a special message from my great colleague in France, M. Thomas, telling me that General Gossot, the head of the technical departments of the French Ministry of Munitions, reported after a recent visit to the British front that he had nothing but praise for our heavy guns and howitzers. He had found them beautifully made in every detail, most accurate and most efficient. One of his colleagues, General Jacquot, speaks equally highly of our new anti-aircraft guns. Credit for this must be given where the credit is due. Previous to the War we were not a military nation, and it was only natural that our designers of war material should pay greater attention to naval than to military armaments. It is a matter for congratulation that our

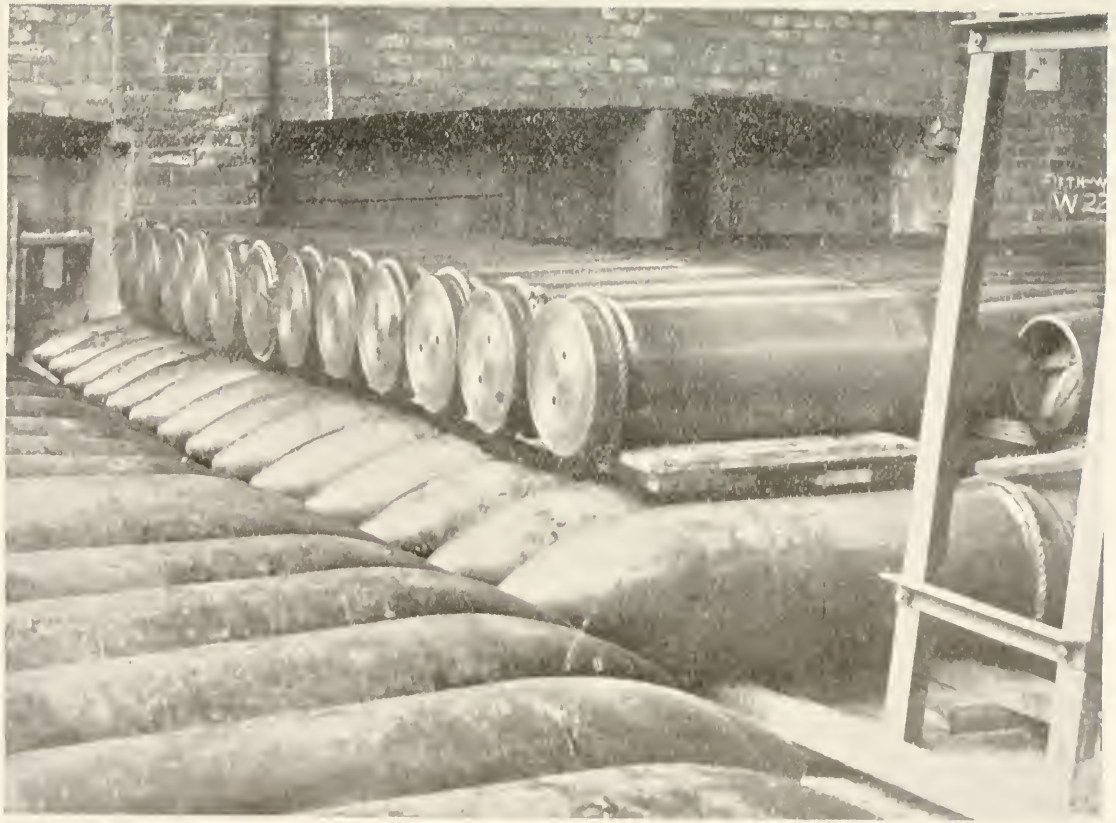
armament firms have produced types of heavy land artillery at such short notice, which have now stood the test of prolonged action. I want to add—I must add—that the types of heavy howitzers now being manufactured in such large numbers were settled before the Ministry of Munitions became responsible for design. The War Office, and particularly the Department of the Master-General of Ordnance, is, therefore, entitled to share the credit with the designers and manufacturers for this satisfactory state of affairs.

Though I say that matters are satisfactory in this respect, it should not be inferred that the Ministry of Munitions is without its problems on the subject of guns. Even when manufactured to the best design and of the best material, guns wear out, and are damaged or knocked out by the enemy's fire. The British Army have suffered remarkably few losses from capture by the enemy. The provision that has to be made for repair, both in the field and at home, is an increasing source of anxiety. During the present offensive the difficulties have been quite satisfactorily surmounted. We are working in close touch with the Ordnance Department of our Army in France, and there is reason for expressing confidence that our

means will prove adequate for this great task, but we shall have to mobilise for renewal and repair increasingly as our ammunition increases. Then, again, the conditions of the present warfare continue to emphasise the value of long range for modern artillery. Our unpreparedness for war has, at least, had one compensation in this respect. Our weapons are all of modern type with good range, when compared with similar weapons in the hands of the enemy. Still, the demand is ever for increasing range as the value of long-range fire becomes more apparent when combined with good aerial observation. All I can say is that the Ministry of Munitions has not been unmindful of this tendency in the past and that it is keeping moving with the times.

## SHELLS.

Now as to ammunition. It is within the recollection of all listening to me to-day that little more than a year ago the character of our artillery ammunition was the subject of much criticism. It is, perhaps, not too much to say that the Ministry of Munitions owes its existence to the urgent demand for an increased supply of high-explosive ammunition that resulted from the operations of the spring of 1915.



Two problems were involved—to increase the quantity and to improve the quality. To a great extent these are conflicting considerations, as all changes in design, however trifling, react on output. This task has been faced. It was difficult for the following reason: We had little experience of high explosives. Our experience was practically limited to one explosive, lyddite. We knew little about a substance which has become famous and is spoken of as T.N.T. But it was quite impossible to fulfil the programme on these two explosives, and the dilution of the latter with other ingredients was a first necessity of the problem. So before we could achieve a solid increase with high-explosive ammunition a whole series of problems involving much research and experimental work had to be solved. These problems have been successfully solved by the Ordnance Committee, and by Lord Moulton's Department, assisted by the staff of scientific chemists who work at Woolwich under the Superintendent of Research. The proportion of high-explosive shells to shrapnel asked for by the Army is now being provided, and although it must be remembered that when you have an improvement in design it is some months before it can be put into the manufactured supply, and before it replaces the

stock of the old design, the results in this country and the reports received from abroad show that during the last few months there has been a steady improvement in the quality of this ammunition.

There is another difficulty that has to be faced. Changes that improve the detonation of high explosives are apt to introduce additional risk. In fact, the artillerist who has to work at this problem is always between two dangers. He has to avoid premature explosions. We have lost some guns through premature explosion. I fear it is very possible that we shall lose more. But in spite of our initial want of knowledge of this subject, in spite of the very rapid rise of output, in spite of the fact that manufacturers without any previous experience have been impressed into this difficult and responsible service, our losses in guns and in personnel from this cause have never been a really serious consideration, and what I think is eminently satisfactory is that the factor of safety has continued to rise with the improvement in detonation and the rapidly increasing output. There may have been some, there certainly were, who, when the Ministry of Munitions was first formed, were doubtful of the wisdom of entrusting such great responsi-

bilities to a body of civilian amateurs. They feared disaster, and in certain cases openly expressed their fears. Those fears may now be allayed. There is room for further improvement —that I am bound to acknowledge. Many hon. Members no doubt still hear from their friends at the front of "duds," and, according to their temperaments or their actual experiences, their friends tell them that our ammunition is better or worse than the German ammunition. It is not possible at the present moment to say whether our ammunition is better or worse than the German. We know that the enemy has his failures just as we do. What the Ministry of Munitions claims is a very distinct measure of success in dealing with a very difficult question and a justifiable confidence of continued improvement in the future.

### TRENCH WARFARE MATERIAL.

Far more so than in the case of artillery, it has been necessary to improvise our trench warfare material. In spite of very considerable difficulties, success in this department has been achieved. Types are becoming settled, and output is very satisfactory. As regards trench mortars, our light and medium types are stated to have done admirable work during the present

offensive. A heavy type has been suggested which has done well, but there is probably more scope for the designer in this class of weapon at present than in any other. I am glad to be able to tell the House that the helmet which is now being supplied in adequate quantities is very satisfactory, and is probably the best in the field. The Ministry has carried out much experimental work with body shields, and we have now some results which are being tested on a large scale in the field. A good deal has recently been said on the subject of lights. Comparative trials have been carried out with our own and captured German lights, and there is absolutely no justification for saying that our own compare unfavourably.

Entrusted as I am with the responsibility for one of the most important branches of the conduct of this war, I do not want to give the impression from what I have said as to improvement of quality that the Ministry is inspired by a snug complacency on the subject. Against such an enemy as Germany we can never afford to stand still, even for an instant. There must be continued progress, or we shall get left behind. My right hon. Friend and predecessor established in the Ministry a separate Department of Inventions, the principal object

A MONSTER GUN IN ACTION.

(*To face p.* 21.)

of which was to encourage invention and initiative. The aim of the Ministry ought to be to carry on its research and experimental work with such energy that whenever the opportunity offers there is always a new and improved design waiting to be introduced.

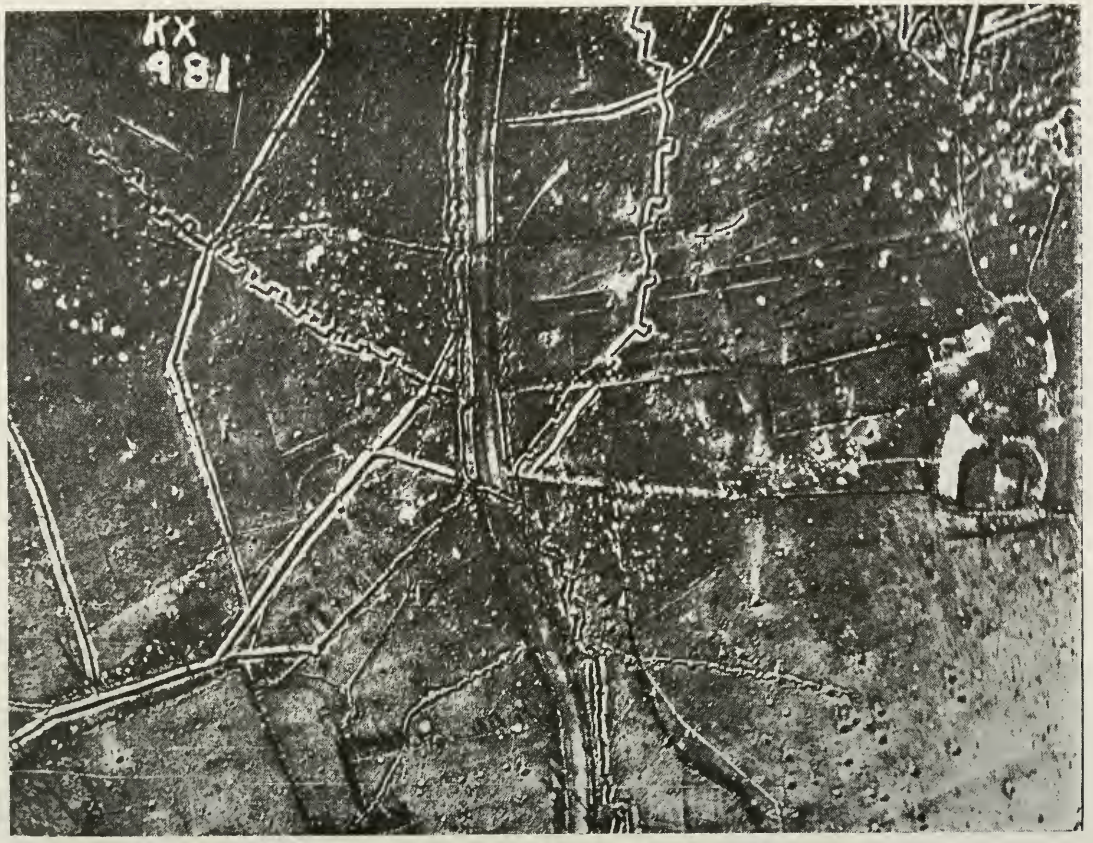
I have now told the House that the quantity of munitions has increased and the quality improved. I think we have all constantly present before us a conspicuous proof of the justice of my claim in the present offensive on the Western front in France.

### HOW THE MUNITIONS ARE USED.

I want, if the House will permit me, to indulge in a short digression. I have tried to understand for myself, in approaching this new problem for the first time, the purpose and the mode of accomplishing the purpose of this vast expenditure of ammunition in a modern battle. I want to give the House the result of my inquiries, in the hope that it will help laymen to understand what is going on, and in the humble hope that it will not arouse the contempt of soldiers.

As I understand it, when an attack is planned against a securely entrenched enemy, with barbed wire everywhere, with elaborate com-

munication trenches, and powerful long-range supporting artillery, the first necessity is to break down the wire and smash his first line of trenches. This means a heavy expenditure of field artillery, shrapnel, and trench mortar bombs for wire cutting, and heavy howitzer shells for trench destruction. If this task is inadequately performed, if the wire checks the Infantry, if machine-gun emplacements remain intact, the attack fails, and fails with horrible results. When the bombardment has disclosed to the enemy an impending attack, the enemy tries to stop it by curtain fire. During the bombardment the enemy, from his observation posts, is constantly watching for the Infantry assault. He concentrates a converging fire from hundreds of long-range guns upon the trench area from which the Infantry must debouch. That fire has got to be subdued, or the attack takes place under a perfect tornado of projectiles; hence the necessity for counter-battery work. An immense expenditure of shells from long-range guns, controlled from the air, whence alone the fire can be directed at the enemy's guns, goes on whenever aerial observation is possible. The guns are well entrenched, and this runs away with an enormous amount of heavy and medium




(A) BEFORE BOMBARDMENT.

(B) AFTER BOMBARDMENT. *(Between pp. 22-23.)*

ammunition. Next the attack takes place. Its flanks have got to be protected, and while the Infantry is engaged in facing the parapet of the captured trenches the other way they have got to be protected from counter-attack. A counter-attack begins by the enemy's bombers coming down the communication trenches and bombing the captured trenches. They cannot be seen—cannot be spotted from the Artillery observation posts. The only means of dealing with them is to direct a barrage fire which sweeps every communication trench, leaving nothing to chance. Later the enemy's more formidable counter-attack comes along. It is organised under cover of concentrated artillery fire by means of massed Infantry from the support trenches. The success of these attacks has not only got to be prevented, but the enemy must not be allowed to formulate them. So the successful Infantry must be protected on its flanks and front by barrage fire of shrapnel and high explosive directed against the enemy's support trenches, where the Infantry, unseen, are organising for the counter-attack.

Finally, to be able to press on successfully from one attack to the next, the resisting power of the enemy must be worn down by want of rest, of relief, of food. All day and

all night the approaches to his trenches must be kept under fire to prevent relief coming to his men, to prevent the replenishment of ammunition supplies, and to prevent his obtaining food and rest. If you add one more detail, what I believe the French call *tire de démolition*, which is directed by the very heaviest howitzer guns against especially fortified nodes which are dotted about the area of the German lines, and consider all the operations which I have described, wonder ceases that you want so much ammunition.

## OUR RESOURCES.

The only marvel that remains is that you can ever produce enough to sustain the attack which goes on week after week, day and night, with varying, but always with sustained, intensity. Writers in the German Press have endeavoured to comfort the enemy by the assurance that our heavy bombardments in the last few weeks have made irreparable inroads into our resources of ammunition—the ammunition which has been laboriously accumulated for months past. It is true that the expenditure of heavy ammunition during the last month has been more than double the amount that only eight months ago was thought to be wanted at the time. The

preliminary bombardment in the week before the attack consumed more light and medium ammunition than the total amount manufactured at home during the first eleven months of the war, while the total heavy ammunition manufactured during the same period would not have kept the bombardment going for a single day. It is, however, a great satisfaction to be able to state that in the larger natures the output of the factories week by week covers the expenditure. If workers and employers continue to play their part nobly, as they are doing to-day, there is now no fear that the present offensive will be brought to a premature conclusion by shortage of ammunition.

### THE MINISTRY AND ITS GROWTH.

I have much more to say, even at the risk of wearying the House. I have just said, as briefly as I could, what has been accomplished, both in amount and in quality. I should like to say a little about the methods by which it has been done. The Ministry of Munitions, although it has only been in existence thirteen months, already numbers on its Central staff over 5,000 persons, and it is growing till it bids fair to become one of the largest Departments of the State. I know there has been much criticism

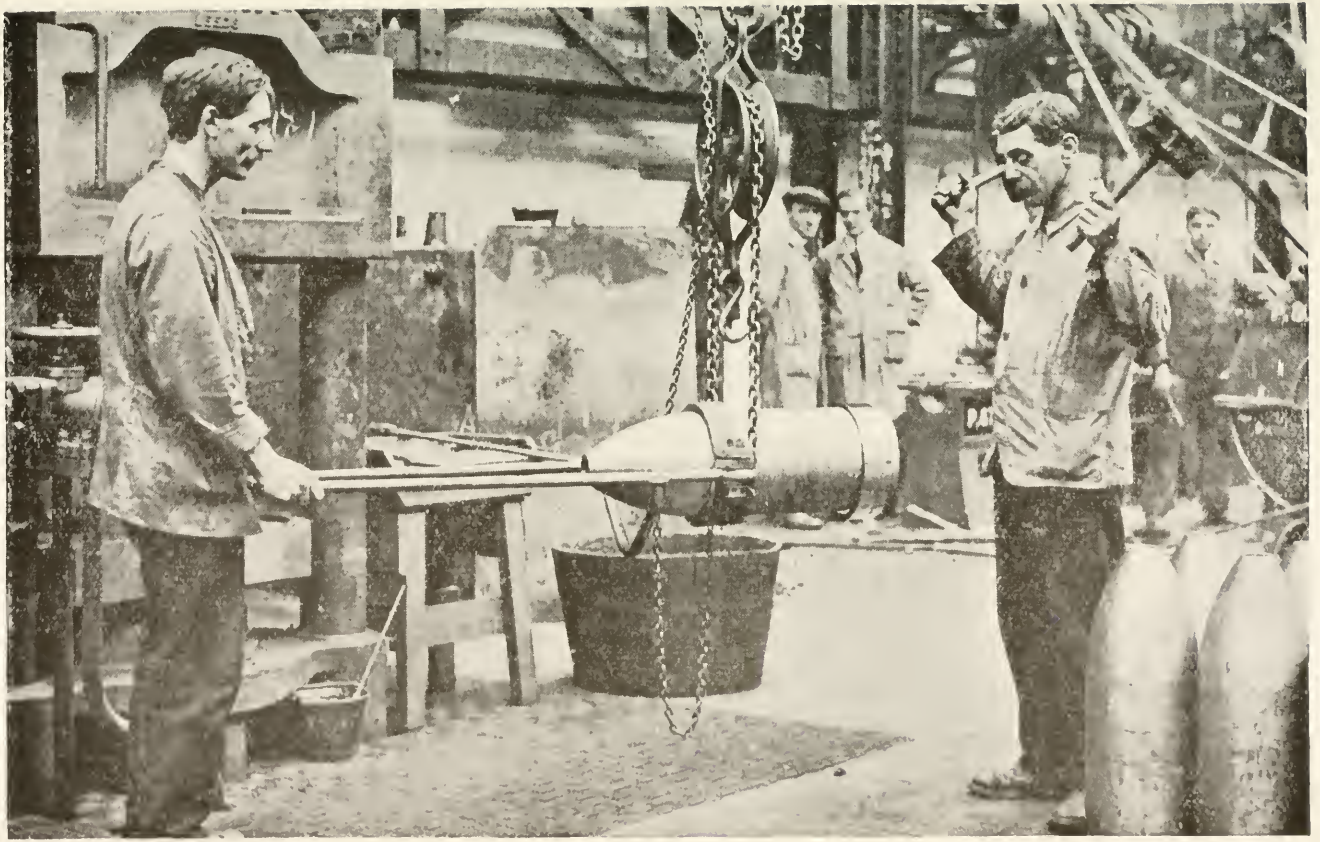
and suspicion of this mushroom growth. I want, however, to ask the House to believe that the growth has been inevitable in view of the increasing variety, diversity, and complexity of the work which we have been compelled to undertake. It is not merely a question of placing orders for a large quantity of materials. My predecessor, when he addressed the House in December last, referred to the extensive organisation which was necessary for following up and expediting the completion of contracts. The Ministry of Munitions is sometimes compared—to its disadvantage—to the corresponding French Department, because the latter is much smaller. But it must be remembered, for one thing, that we have to do a great deal of administrative work here which my colleague in France is spared. Thus, the problem of labour organisation in France is far simpler than it is in England. They have no Munitions Act to administer. They need no such system of leaving certificates or of munitions tribunals as we have had to set up. They have not to administer the limitation of profits in some 4,000 controlled firms. They are spared many of the complicated problems created by the suspension of trade union regulations and the introduction of the dilution

of labour. The release of soldiers from the Colours for munitions work can be far more simply performed in France than in England. I would ask anyone who is disposed to criticise the size of our administrative staff to remember that we have to control an expenditure of far more than £1,000,000 a day. If you compare the cost of the central staff with the amount of its expenditure, the cost of the central administration is low, and amounts to less than one-sixth per cent.

### A MORNING'S WORK.

I want to give the House a trivial illustration, if I may, of the variety of matters with which the Ministry deals. When I was told that I had to make a statement on the Munitions Department, I cast my thoughts back over the matters with which I had to deal on that particular day. I began with a friendly controversy with a Government Office about the transport from near the Arctic Circle to a neutral country of a mineral the name of which was unknown to me, but which I was assured was the limiting factor in the output of certain indispensable munitions. I went on to discuss the question as to whether we should press the India Office, in the interests

of the munitions supply, to construct a certain railway line in a remote part of India. There was a question of certain measures affecting the output of gold in South Africa. There was a discussion as to the allocation of a certain chemical, very limited in quantity, to meet the competing needs of the Army, the Navy, and the Air Service. There was a deputation from an important educational institution asking to be allowed to continue certain building operations. There was a discussion about the men deported from the Clyde. There was a discussion on certain contracts in America valued at over £10,000,000 sterling. In the course of the morning the Munitions Inventions Department brought to see me some walking specimens of exceedingly ingenious artificial legs. There was a conference on the allocation of several highly skilled workmen of a particular class amongst competing firms. There was a discussion as to the quickest means of manufacturing gun carriages. There were a hundred and one topics which must confront any body of men who spend their whole days watching curves which ought always to go up and figures which ought always to swell; reading reports from all parts of the world, and confronted always with the cry:



FIXING COPPER BAND.

(*To face p.* 28.)

"More, more, more!" and "Better, better, better!"

### SOME BRANCHES OF THE WORK: INSPECTION.

I can only choose, as I have said, one or two aspects of the administration of which to tell the House. The first one is the question of inspection. Inspection grows, of course, and the inspection department grows *pro rata* with all classes of munitions. The whole programme is dependent upon its work keeping pace with the output. It is sometimes thought—until a very short time ago I should have thought it, if I had thought at all—that inspection means taking one or two samples out of a number of articles, looking at it, and telling by touch or smell whether it ought to be passed or rejected. As a matter of fact, inspection involves the most careful testing and gauging of every article that is passed, and that is a process in production which involves a very large factory staff. The average type of shell requires 30 gauges, a percussion fuse 100 gauges, and a time fuse 240 gauges. As these gauges must fit to within less than a thousandth part of an inch, and in most cases one-third of that figure, to obtain uniform results, it will be understood why the supply of gauges has been

one of our greatest difficulties. An even greater difficulty was the supply of adequate staff. In France and other Continental countries a large staff of officers, who had been trained in the technical artillery schools, was in existence at the beginning of the war, and was turned to supervision of manufacture and to inspection. The outside administrative staff of the Munitions Department in France is, consequently, almost entirely military. In England it is mainly civilian, and it has been created during the last eighteen months.

We owe a great debt of gratitude to the small core of Artillery officers who alone, at the outbreak of war, possessed the necessary knowledge and experience for controlling inspection, and who have formed the nucleus round whom the vast staff which has been formed has grown up. A large body of engineers has been specially trained in a school of instruction at the Ordnance College at Woolwich, and these men constitute the inspectors and assistant inspectors throughout the country, and they have a great deal of administrative as well as technical work to perform. They supervise the work of the examiners who handle the gauges and carry out the actual operation of inspection. The training of examiners for this inspection

work is also a matter of great importance, and it is satisfactory to note that women are now being largely and successfully employed for this purpose. The staff employed by the Department has grown during the past three months from 19,000 to 30,000. Of the total, 14,000 are women, 9,000 of whom have been appointed in the last three months. The Inspection Department have a great responsibility in that guns, shells, fuses, and all other munitions to be of value must not only be dangerous to the enemy, but safe to the troops using them, and to ensure this is by no means an easy task, having regard to the immense volume of all warlike stores now demanded for operations in all theatres of war. Not only have you got to preserve the *morale* of your men by supplying them with munitions which give neither "prematures," which kill them, nor "blinds," which fail to kill the enemy, but you have got to remember that "prematures" very often destroy the guns, and therefore safety of inspection is one of the prime necessities of supply. I trust that manufacturers will remember that when they are disposed to chafe at the tedious and elaborate processes of inspection, which are, of course, a check on output, but an

essential and, I hope, the only welcome check on output.

### COMPLETION AND TRANSPORT.

The next Department to which I wish to draw the attention of the House is the Department which deals with marshalling and completion of ammunition. The manufacture of constituent parts of ammunition may be carried on all over the world. These components come from everywhere in an increasing stream by rail and by sea. The stream has got to be regulated so as to avoid congestion and, at the same time, bring an adequate supply of finished components for the filling factories. It is like a highly complicated chess problem to keep everything moving on a colossal scale, and it is made all the more complex by the fact that our supplies of components come from all over the world. You cannot control the supply in country overseas. Railway transport is not subject to our regulations, and the arrival of shipments is necessarily irregular. So we have had to set up a special Department formed to deal with home transport, and a second to deal with overseas transport. The latter is now handling, in co-operation with the Admiralty, 1,300,000 tons of freight

monthly, including materials from Spain, Scandinavia, West Africa, the Far East, Chili, the United States, and Canada, and the quick discharge of ships to enable freight tonnage to be used to the best advantage, the expeditious clearance of railway wagons—all these are practical steps of great utility, and everyone who helps to shorten up any one of the stages of transport or handling of material is helping the country at the present time. When the components have been marshalled and assembled, they are dealt with by the filling Department of the Ministry, the development of which has been one of the chief features of the last six months. This development reflects the greatest credit not only on the head, but on the military and civilian officers assisting. While the tonnage of completed gun ammunition issued from the filling factories has risen in six months nearly four-fold, the administration expenditure per ton has been halved. This increase of tonnage takes no account of the enormous quantities handled by the Explosives and Trench Warfare Departments.

### THE NEW FACTORIES AND THEIR SUPERVISION.

Then I turn to another part of the machine. The supervision and control of the Government

factories need a very large staff. Before the War there were three national factories working for the land service. Now there are ninety-five. These factories include eighteen factories for filling gun and trench-mortar ammunition, all of which have been ordered, planned, and built during the last twelve months, and all of which are under the direct management of the officials of the Ministry. One of them is filling nearly twice as much as Woolwich, which, for the first eighteen months of the War, carried practically the whole of the burden of completing ammunition. There are thirty-two national shell factories, which are managed by local boards of management under the supervision of the Ministry. I cannot mention those factories without referring to the highly efficient local area organisation of which they form part, built up under the personal direction of one of the captains of industry whom my right hon. Friend roped into his net, with the enthusiastic co-operation of the foremost men in the engineering industry all over the country. Some indication of the work accomplished by these Boards of Management in organising new sources of supply is given by the fact that between September, 1915, and August, 1916, the factories for which they

were responsible, none of which had ever handled a shell before, produced in certain natures of shell four times the output of these shells during the first ten months of the War. Then there are twelve national projectile factories in various stages of completion occupied in making heavy shell under the management of large engineering firms supervised by the Ministry. These also are all in buildings which have been ordered, planned, and built by the Ministry of Munitions. They have just, to-day as I speak, barely developed one-half of their total capacity, but they are already sending out 25 per cent. of the heavy shell produced in this country. I have got some figures of a form familiar to the House. I am told they cover an area in buildings of seventy acres. They consist of bays with an average breadth of fourteen feet, and a total length of fifteen miles. They contain 10,000 machine tools, which are driven by seventeen miles of shafting at an energy of 25,000 horse-power, and their daily output would fill a train one mile long composed of 400 trucks, and requiring eight engines to pull it. They are very largely operated by women's labour. The number of women employed in them is already about 15,000, although a year ago we were told it

was impossible for women to manufacture heavy shell.

I think the nation is under a great debt of gratitude again to the men who have been responsible for the establishment of those factories, and to the courage, faith, and perseverance of those responsible for the labour policy which has rendered these factories effective.

Of the remaining national factories twenty-two are concerned with the manufacture of explosives and their raw materials, six with the manufacture of cartridges and cartridge cases, while one makes nothing but gauges, and another nothing but small tools.

### OUR INCREASING INDEPENDENCE.

They serve two purposes: first of all, they render us independent of supplies from abroad; and secondly, their administration affords us invaluable experience for controlling the whole volume of munitions. As regards the first point, my right hon. Friend pointed out eight months ago its importance, and the Ministry has been improving it. At the time the Ministry of Munitions was started, the percentage of American orders was 70 per cent. of the total output of light shell. We are now able to do altogether without any American supply of light shell bodies,

and these orders are in process of being discontinued. As regards heavy shell, American supplies have been invaluable during the development of the new factories, and the orders are still required; but if home and Canadian output comes up to expectation, we ought ultimately to be able to do without American shell altogether. I do not like to pass on without saying that the House of Commons is aware that Messrs. Morgan are our purchasing agents in America, and without expressing our admiration of the way in which they and the American contractors have organised a proportion of their great industries for the output of munitions.

## FINANCE.

As to the second point, that of controlling by means of national factories the output of munitions, I want to say a word as to the finance branch of the Ministry. The finance branch of the Ministry of Munitions, which controls an expenditure of, as I have said, over £1,000,000 a day, has been given deliberately far greater powers than, I understand, is the case with the finance branch of other spending Departments. It retains a supervision over the financial clauses of all

contracts during their negotiation. It has not had to use at all largely the power of examining the costs of manufacturers conferred by the Munitions Acts and the Order in Council. We have made alterations in costs with the concurrence of manufacturers.

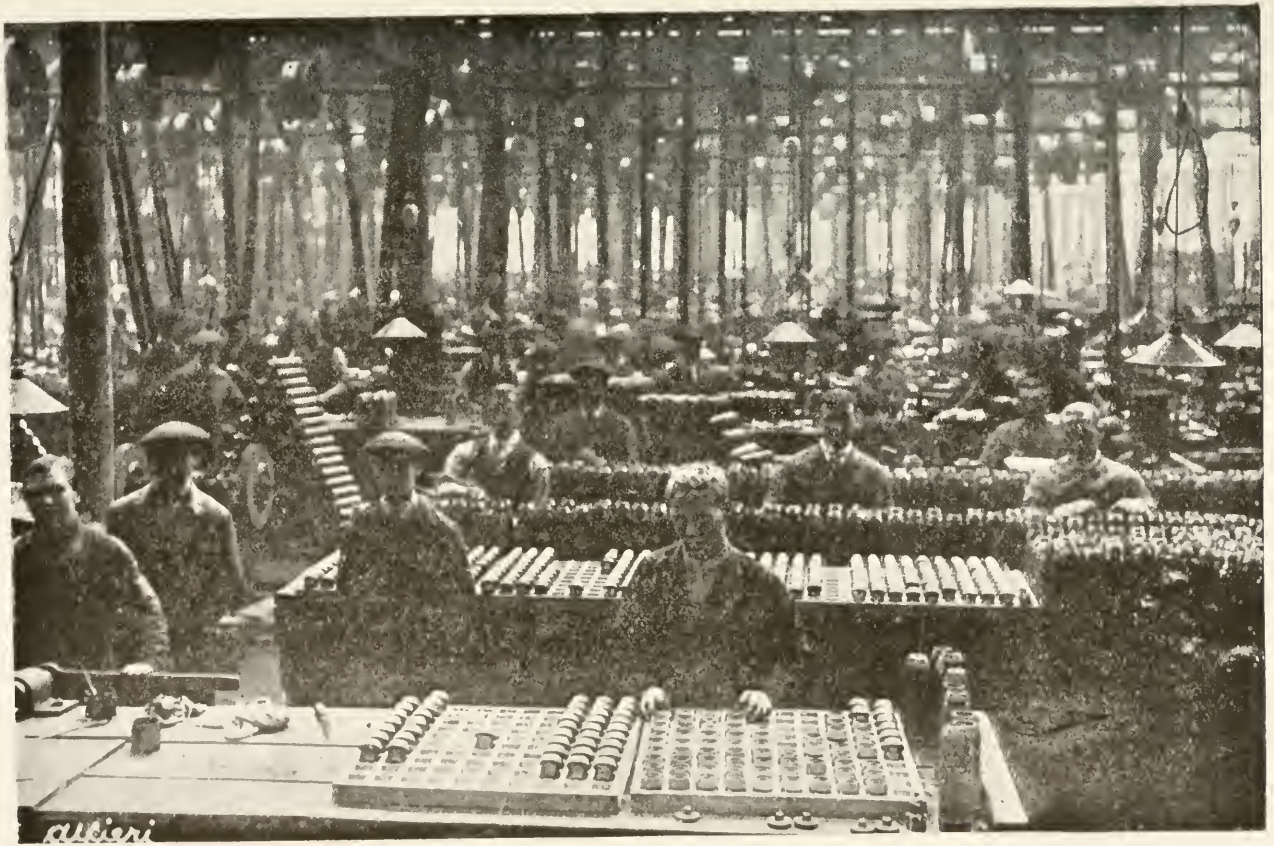
The key to the problem of financial control has been provided by the cost accounting system introduced into our own factories. The knowledge so gained has enabled the Ministry to put their finger on the weak spots in administration and extravagance in the factories themselves, and has afforded a standard to check contract prices. The cost of the factories, which was high at the start, has fallen rapidly, and is now much less than the 1915 contract prices. The reduction in home contracts which has ensued represents a saving in the case of shell of £20,000,000 a year. American shell contract prices have been reduced 15 per cent.; Canadian shell contract prices 12½ per cent. Fuse, Gaine, and T-tube prices have been lowered from 20 to 25 per cent., and trench warfare munitions from 40 to 50 per cent. Similar reductions have been made in the prices of explosives, ammunition boxes, and small-arms ammunition. It is worth recording that the cost of the large explosive and pro-

pellant factories erected, or being erected, in this country will be completely covered in from six to twelve months by the difference in the cost of their output and the price of these articles imported.

### CONTROLLING TRADE.

Now I want to draw the attention of the House to the extent and variety of our interference with the commercial and even with the private life of the country involved in the results which I have given. Germany, let us never forget, was organised for war. Her ceaseless and intelligent preparations had given her the workshops, the arsenals, the machine-tool factories, the chemical factories, the skilled labour necessary to equip an Army of many millions. We had no Army, at least comparatively none; we had no intention of being a military power; and while our industries were peace industries, Germany was able to mobilise her second line of industrial defence and to use her dye works and her fine chemical works by turning them into explosive factories. We followed her example after the War, but we had to begin from the beginning, and the demand for munitions of war has entailed a most comprehensive disturbance of the

chemical and engineering trades of this country and of their allied and dependent industries. The State has had to step in and control them to an extent which no one a few years ago would have expected the country to tolerate for a moment. For this purpose we have had to establish an elaborate system for instructing Government contractors as to the order of priority which they are to assign, not only to Government, but also to all private work which they are asked to undertake. Again, we have had to fix maximum prices for steel, iron, and coke. We have had to regulate iron-ore freights from the Mediterranean and from Spain. We have had to prohibit speculation in certain metals and to place others under regulations whereby dealings are prohibited without licences. Then there is the case of the machine-tool department, which exercises complete control over the whole of this section of the country's trade. No machine tools can be ordered from Government or private works without the authority of the Department. It controls the supply of machinery to all Government contractors, as well as the Allies and neutral countries and for private work. It has exercised very freely the powers which the Ministry possesses for removing existing




SHELL-MAKING AT SHEFFIELD.

(*To face p.* 40.)

machinery and transferring it to places where it is needed for the manufacture of munitions.

Again, our building programme necessitated our stopping private building. We have 1,500 applications now under consideration which we hope will lead to a large supply of available building labour.

### THE WORKERS.

I think it is on the side of labour that we have interfered most with the rights of the individual. If I say that we are to-day far better off in regard to the supply of labour than we expected to be a year ago, I hope no one will think the problem has been solved, and it cannot be solved as long as there is an Army in the field. Our task has been to take the strictly limited supply of labour and spread it as thinly as was compatible with efficiency over the whole demands of the nation. This has only been done by what is called "dilution," and it is only by dilution and further dilution that we can carry out the programme we have set ourselves. There are other expedients which have been helpful—something has been done by bringing back men from the Colours to supply skilled labour. Forty-five thousand soldiers have been released

from the Army and are now employed in munition factories. They have come from 4,000 different units, and have been distributed amongst 3,800 employers. These men have greatly helped to make possible the large increase in the number of persons employed in munition trades. Then we have schools for the education and training of skilled and semi-skilled labour. Over 500 people have been trained as tool-setters to work on one special type of machine; nearly 200 plumbers have been trained as lead burners; and 130 jewellers have been trained as gauge makers. These are examples of what can be done by our system of training centres and university departments, and I trust employers will avail themselves more of the supply. Then there is the War Munitions Volunteer scheme, which has yielded 13,500 skilled labourers who have actually been transferred to war work.

By utilising these various resources the following results have been achieved: When the Ministry of Munitions was started the number of persons employed was 1,635,000. By June of this year this number had increased to over 2,250,000. Of these about 400,000 are women, which is nearly double the number employed a year ago. The proportion of women is increas-

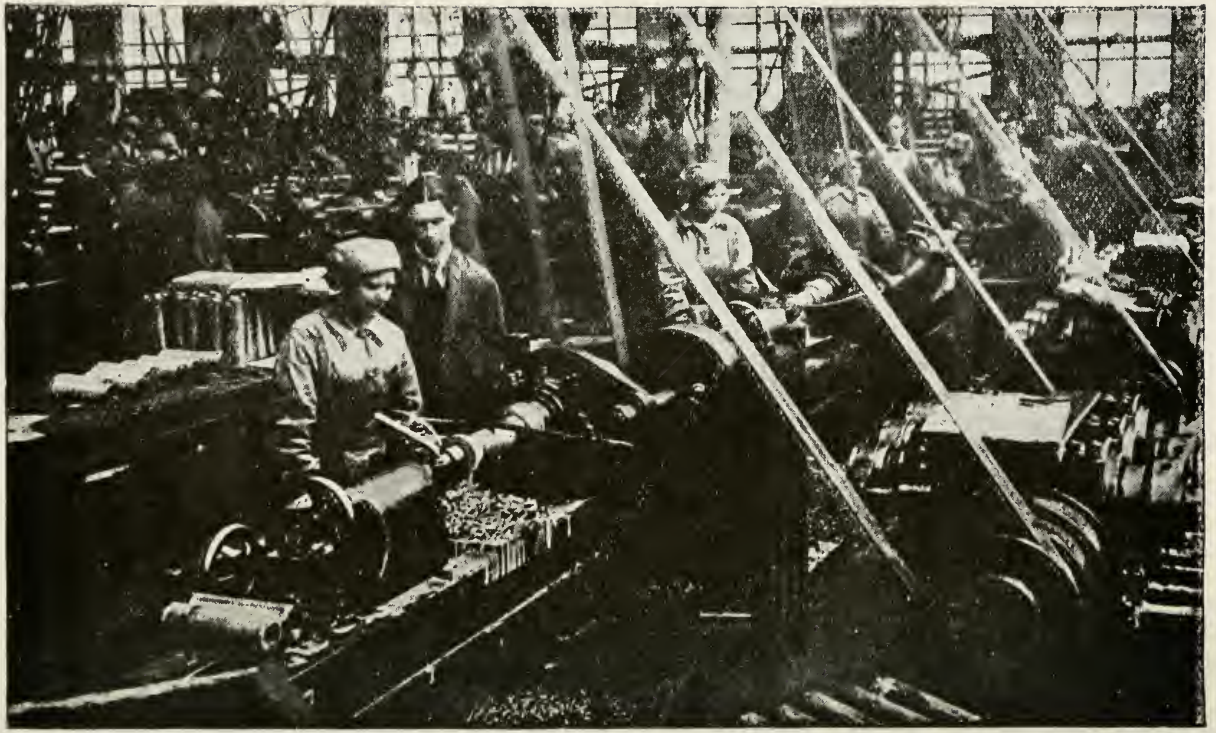
ing rapidly. In 1914-15 it rose from 9 to 11 per cent., and in the last year it has increased from 11 to 17 per cent. But in spite of all these advantages, I have to say once again, notwithstanding that men have been brought from the Colours and that men have been specially trained, the only real way of meeting the difficulty is by an increased application of dilution.

## OUR DEBT TO LABOUR.

Now I have shown how we have increased our output, improved its quality, how we have done it and disturbed trade to do it, and I want to complete the picture by expressing our debt to those people in particular to whom, I think, we owe it. We could never have secured this development unless the whole heart of the people was in the cause. Wherever we have asked for help we have got it. Wherever we have demanded services men and women have laid aside their own interests in order to serve the cause. I need not enlarge upon the services of the staff who have been working without intermission at the highest pressure in the offices at the centre and in the district areas into which the country is divided. But I want the House to consider for one moment the debt we owe to labour,

skilled and unskilled. For forty years organised labour has been endeavouring, through the trade union movement, to win recognition for certain principles which are held to be necessary to secure a proper recompense and an equitable share in the control of industry. When the War broke out there were disputes in progress, and many grave industrial questions seemed likely to arise in the near future. The declaration of war required that a truce should be declared, and from that moment the time which might have been used as a period of preparation for a contest between capital and labour was consecrated to the services of the whole nation against the common enemy.

But the cessation of disputes and the postponement of the reforms which slowly emerge from the clash of conflicting interests do not exhaust the full measure of the sacrifices which organised labour has made. The trade unions placed on one side the whole armour of trade union regulations upon which they had hitherto relied. For all the weapons slowly forged during long years of struggle—rules and customs relating to hours of labour, overtime, the right of entrance to trades, demarcation of industry, the regulation of boy labour, and the exclusion of women from certain classes of occupation—all these



WOMEN SHELL-MAKERS.

(*To face p.* 45.)

directly or indirectly might have tended to reduce the output during the War. The Government asked Labour to put all these on one side. It was a great deal to ask. I doubt if any community has ever been asked for greater sacrifices, but with a loyalty and statesmanship which cannot be overestimated, the request was readily granted. The trade unions required, and they were right to require, a scrupulous record and recognition of what they were conceding. It was promised to them as a right, but they will receive more, not only the restoration of the system they temporarily abandoned, but the gratitude of the Army and of the nation, and they will, I trust, place the nation still further in their debt by playing an important part in devising some system which will reconcile in the future conflicting industrial interests.

### THE WOMEN'S PART.

Now I want to say a word about women. Women of every station, with or without previous experience of the difficulties, or of the strain and monotony of munition work, have proved themselves able to undertake work which before the War was regarded as solely the province of men, and often of skilled men alone. Indeed, it is not too much to say that

our Armies have been saved and victory assured largely by the women in the munition factories, where they helped to produce aeroplanes, howitzer bombs, shrapnel bullets, shells, machine tools, mines, and have taken part in shipbuilding —there are, I believe, some 500 different munition processes upon which women are now engaged, two-thirds of which had never been performed by a woman previous to twelve months ago. I do not want to elaborate this point, because it is well known to the House, but I ask the House to consider this, together with the work done by women in hospitals, in agriculture, in transport trades, and in every type of clerical occupation, and I would respectfully submit, when time and occasion offer, it will be opportune to ask: Where is the man, now, who would deny to women the civil rights which she has earned by hard work?

### A WILLING NATION.

We have also had to call on employers and capitalists to make sacrifices. Those sacrifices have been equally heavy and their patriotism equally marked. It has not infrequently happened that employers and workpeople have had the exceedingly galling experience of being pulled up short when production was just getting

into full swing. I can assure the country that the Ministry does its utmost to prevent irregularity in its demands, but war does not run according to schedule. New phases of the War create new necessities and demand changes, and recognising, as I do, how unpleasant this experience is—particularly when the work has been undertaken not from a sense of profit, but from a sense of duty—I am certain workpeople and employers alike will continue to put up with the inevitable in the same cheerful spirit which they have shown in the past. Our achievement really is explained by the simple fact that the nation was willing. You cannot govern an unwilling nation, but there is nothing you cannot do with a willing nation. The response to our appeal for a postponement of Bank holiday is a very good example, and it has been cheerfully accepted on both occasions by the workpeople. We have decided to inaugurate a period of rest at the end of September for certain munition works where relay holidays have been found to be impossible. I trust that this will not be transformed into a national holiday, because it is only intended as a recognition of the fact that machinery and men, and still less women, cannot be worked for ever without a halt for repairs.

### THE CREATOR OF THE MINISTRY.

And now I want to pay one other tribute, and perhaps it is the most important. When the War began, the work which our staff of 5,000 people in London alone is now doing was done by the War Office. A nation which had enjoyed a century of security and was defended by an incomparable Navy had always grudged expenditure of money on military preparations, and the soldier had to plough his lonely furrow without the sympathy of the civilian. Is it to be wondered at that it took some time for the War Office to realise that in this War it was not a soldier's or a civilian's war, but the whole nation's war, and the whole nation for the first time were eager and anxious to co-operate in producing all that was necessary? But apart from this, it must be remembered that the War developed slowly, and that even the soldiers who were responsible for the conduct of operations, and upon whose advice the supply of munitions must ultimately depend, could not be expected at once to formulate their final requirements and to anticipate the vast scale and the endless variety of munition supplies which were to confute the teachings of professors and exceed the vision of prophets. The controversy between high ex-

plosive and shrapnel was a controversy settled after much discussion in the fields of France. The knowledge of high explosives which was wanted was not forthcoming until it was crystallised by trench warfare in the Spring of 1915. The great lesson of the early months of the War was that munitions cannot be obtained merely by ordering. You have got to see that the man who takes your orders has the plant and the labour; you have got to follow up the work process by process; you have got to provide from the beginning to the end everything that is necessary. That is the cardinal principle of the Munitions Department. That is the lesson learned in the first months of the War, and it was this main conception with which my right hon. Friend left the Treasury to build out of nothing the Munitions Department and the wonderful output I have described. Everything I have said of our success is a tribute to him. He chose the great leaders of industry who formed the pivots of our machine. He formulated the needs of the moment to Labour, and persuaded them to agree to meet our necessities. He realised the scope which our operations should embrace in all the essentials of the production of munitions, and his tireless energy and vigorous personality were the inspiration of the whole vast

fabric. He set himself to do more. He realised how much of our prospective supply of big guns was hypothecated to the Navy. He realised how long it took to collect the raw materials and to train labour. It is no secret to say that he ordered far more heavy guns than was then thought by the War Office to be necessary. It is no secret to say that before he left the Ministry of Munitions he had the satisfaction of receiving new requirements from the War Office, which showed that he had not ordered too many, but too few ; and yet, notwithstanding that, it is due to his foresight that the surplus guns will be all ready in or about early spring of next year. For this one courageous feat alone and for the Ministry as a whole—in saying this I do not for a moment underrate the help which he has received—the country owes him the greatest debt of gratitude.

### THE NEAR FUTURE.

When I say that, I hope the country will not think that all has been accomplished, that our task is complete, and that the end is in sight. Much remains to be done. Our home resources are not yet fully developed. Our dependence on foreign supplies still exists. We have got to keep the organisation up to

its mark. We have got to extend it. We have got to overcome difficulties and shortcomings which have been revealed. We have got to anticipate and remedy new difficulties. We have got to devise improvements and achieve a still greater output. The success of our Army is bound up with the supply of big guns, and, though the figures which I have given show that much has been already accomplished, our programme of guns will not be fulfilled till the Army's equipment of heavy Artillery is raised to many times its present strength, and our supply of ammunition must not cease to grow till we are in a position to maintain indefinitely along the whole of our front the present expenditure of ammunition on the Somme. The output of Germany is still increasing, and the end will not be in sight until we have established an Artillery superiority everywhere. The resources of Russia and Italy are insufficient to enable them to establish this superiority for themselves, and I think we must look forward with pride to the fact that a considerable proportion of the further munition-producing capacity next year will be required for them. In war it is as great a thing and as profitable a thing to arm and equip our Allies as it is to arm and equip our-

selves. Thanks to our Navy, our resources are unimpaired and our shores are inviolate. Invaded France, despoiled Belgium, temporarily occupied Serbia, gallant Russia—with its ports of entry limited by ice, by distance, and by the Dardanelles—all these must find part of their supplies here, profit by our organisation, and be assisted by our munition workers. And, if I may say so, particularly for Russia, the achievements of whose gallant soldiers are at this moment filling every Allied country with pride, particularly for Russia, whose wonderful and self-sacrificing heroism did so much to stem the invasion of the Germans into France in the earlier months of the War, whose success this year helped so much in the Italian victories over the Austrians, and who is now engaged in putting the finishing strokes to Austria-Hungary, particularly for Russia ought we to redouble our efforts and to prove not only our willingness, for that is certain, but our capacity to help.

### THE FURTHER FUTURE.

Then, is there nothing else? I trust that I shall not be accused of travelling beyond my functions when I ask this question: Is that all? We have organised British industry for the production of munitions. This organisation

covers the country and touches our daily life at a thousand points. Scarcely any of the articles which it is the object of this organisation to produce are simple in construction. Some are as complicated in their mechanism as the finest watch and yet are put together only to be blown out of the end of a gun. We have learned in this process that where the enemy had an advantage was first and foremost in the application of thought to business results. Old-fashioned machinery and slip-shod methods are disappearing rapidly under the stress of war, and, whatever there may have been of contempt for science in this country, it does not exist now. There is a new spirit in every department of industry which I feel certain is not destined to disappear when we are at liberty to divert it from its present supreme purpose of beating the Central Powers. When that is done, can we not apply to peaceful uses the form of organisation represented by the Ministry of Munitions? I am not thinking so much of the great buildings which constitute new centres of industry, planned with the utmost ingenuity so as to economise effort filled with machines of incredible efficiency and exactitude. I wish rather to emphasise the extent to which all concerned—and each

section is vital to our objects—are co-operating to obtain the best results from the material in our hands. We have the leaders of all the essential industries now working for us or co-operating with us in the Ministry. The great unions render us constant assistance in the discussion and solution of difficulties, whether with our officers or within their own body. On technical questions of the most varied character we have the advantage of the best expert advice in the country.

We have in being, now that British industry is organised for war, the general staff of British industry. I am sure that we should sacrifice much if we did not avail ourselves of that staff to consider how far all this moral and material energy can be turned to peaceful account instead of being dispersed in peace time. What are we to do with our machines and our factories? How are we to demobilise our labour? How are we to carry out our undertakings to those who have earned our recognition? How, in a word, are we not only to restore the conditions of peace, but to make peace more real and precious to all concerned? In the solution of these riddles, which we fail to solve at our peril, we shall need the continued help of all that intellect and experience which has rallied

to us for our country's sake. But we must not take our eyes off our immediate purpose. If I lay stress upon the Ministry of Munitions in its achievements, no one will accuse me of claiming any personal credit. More than that, I am sure that my predecessor will agree with me in saying that anyone with our responsibility must feel that his duty lies, not in denying that it is possible for his Department to make a mistake, but in an unwearied endeavour to eliminate a larger and larger proportion of the errors which must arise so long as men and materials are what they are. It is for us to invite and accept criticism, to welcome suggestions, and to encourage inventions until the day when the finest and most flawless material is unfailingly and amply supplied to the finest Armies in the world, until the day when we have rescued civilisation from the menace and treachery of our enemies, when we have avenged honour, punished barbarity, restored security, and established peace by the final and lasting defeat of those who have sought this war.

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